

# THE STATUS OF THE GHARIAL (*GAVIALIS GANGETICUS*) IN U.P. AND ITS REHABILITATION

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(With a plate and two maps)

## INTRODUCTION

Not very long ago, several rivers in U.P. had a good number of gharials. In the course of short period of about fifteen to twenty years, there has been drastic depletion in their population so much so that some of the rivers, have been completely denuded. The situation has become alarming and the gharial is almost on the verge of extinction in this State.

A variety of causes contributed to the large scale destruction of gharials. Some of these are (i) Lack of enforcement organisation. (ii) Indiscriminate shooting and netting. (iii) Use of nylon gill nets for fishing. (iv) Construction of reservoirs and barrages and (v) Removal of eggs by tribals and local people for use as food.

A study of gharial population in Uttar Pradesh was initiated from Jan. 1975 onwards and three main rivers namely Ganga, Sarda and Ghaghra were surveyed. It was also decided to construct hatchling ponds so that eggs collected from nature could be hatched and reared at the rehabilitation centre. The intensive survey yielded solid results in the form of a clutch of 38 gharial eggs which were collected in April 1975 from the west bank of the river Girwa near Katernia-ghat in Bahraich District. These eggs were transported to Lucknow for artificial incuba-

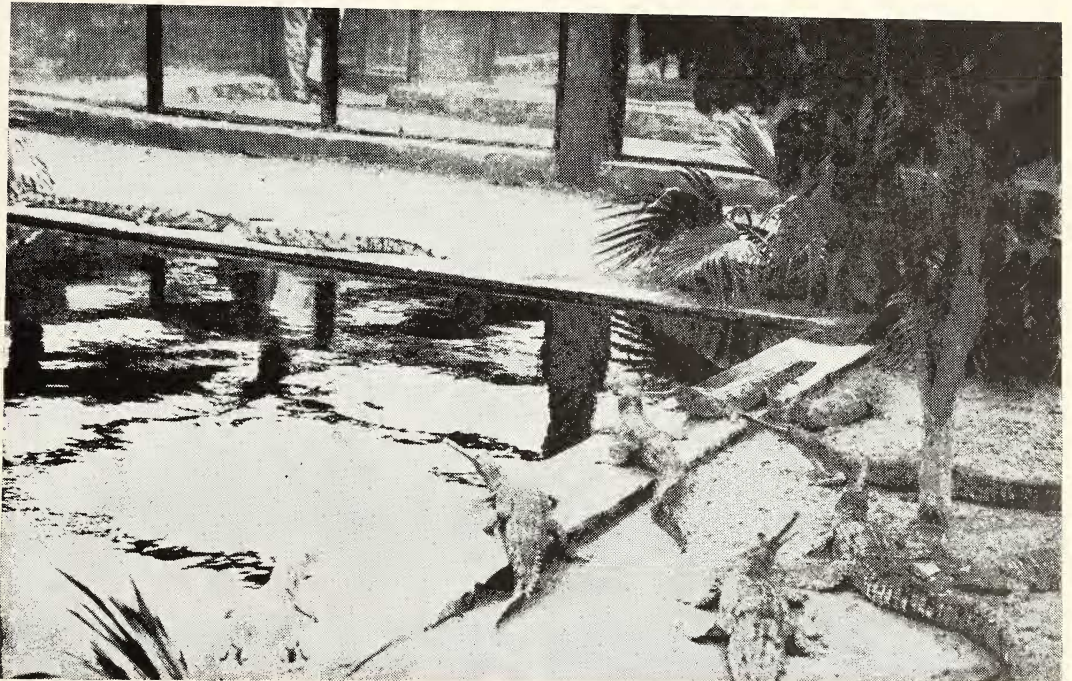
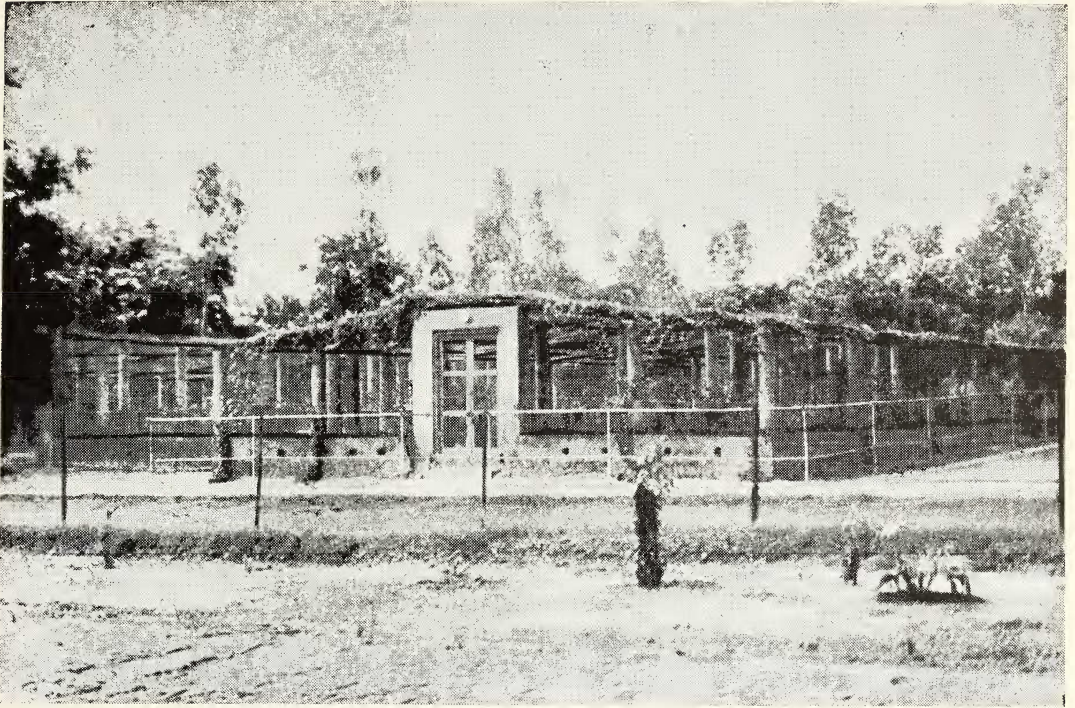
tion, hatching and rearing of the young. Twenty one of the eggs hatched and these were kept in two ponds constructed according to our own design and plan. The centre was visited by the FAO expert and we discussed in detail the entire problem of gharial rehabilitation in U.P. and worked out a scheme, incorporating the following main features:

- (i) Detailed survey of the existing crocodilian population in the State.
- (ii) Based on the information collected through survey, to translocate isolated populations; to protect the viable populations and to locate nesting sites.
- (iii) Establishment of breeding Centres.
- (iv) Essential research on the ecology of crocodilians which will provide basic data about their breeding growth, food habits, population etc.

With financial aid from the Central Government for the execution of the scheme, notable progress was made towards achieving the four objectives. We have surveyed our rivers, located breeding populations and nesting sites; collected eggs, hatched them and reared the juveniles at our rehabilitation Centres. We have at present (August 77) the largest gharial population anywhere in the World. In this paper, however, the results of the survey to determine the status of gharial and the efforts made to rehabilitate this species in nature by rearing them at the Centres is reported.

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*Above : Gharial breeding centre at Kukrail.  
Below: Gharials in Kukrail breeding centre.*





## STATUS OF GHARIAL IN U.P.

### II. STATUS SURVEY OF THE GHARIAL IN THE RIVERS OF UTTAR PRADESH

#### *Methods*

The survey team consisted of a surveyor, two assistant Surveyors and 3 boatmen. Other than the surveyor, the rest of the staff are members of *Mallah* community, who are very familiar with the habits and natural history of river animals. The two Assistant Surveyors have been employed under this scheme as regular Government employees and the rest worked on daily wages basis. Two boats were constructed, one for the river Chambal and the other to be used in Girwa river. Survey of other rivers was done with the help of boats taken on hire. Valuable information about the location of gharials was obtained from local fishermen through our staff.

Two 7 x 50 binoculars were used and census figures are based mostly on day counts of animals seen. Day census is often as effective as night census though hatchlings and juveniles showed up mainly during night counts using three-cell torches when they were feeding near the shore, adults were never spotted during the night.

#### *Survey Reports:*

##### **Narayani or Gandak river**

The Gandak river (Narayani) after leaving Nepal flows through the Doma forests of Nichlaul Range in Gorakhpur district along the U.P.-Bihar border. A large population of Gharial used to be found here. Thomas W. Webber in his book *THE FORESTS OF UPPER INDIA* (1902) mentions seeing groups of 20 or more basking in the mid-river sandbars. In addition he also mentions that mugger used to abound in jheels and tanks around Gorakhpur itself.

Two to three animals were reported seen

in 1975 near the Tailfall gate on the main Gandak West Canal. Two gharials both without nose humps about 2.5 to 3 metres in length were seen in the canal itself but during a period of high water, when the gate was open, one had moved away.

The Irrigation department official who resides near the gate sighted this remaining gharial basking on the sand bank of the canal between 1100 and 1600 hours. During the lean period of the river before the monsoon begins in late May, Gharials are seen in the Gandak river which then flows through a narrow channel on the Bihar side of the border. During this period they are sighted in small numbers (less than 5) at the Gahanu and Bhainsaha ghats. There was one reliable report that the area was visited by a gharial with a nose hump during the first floods in June/July but it has not been seen recently.

Gharials in this area have become rare because of altered habitat conditions arising from diversion of Narayani water in the East and West Gandak canals. As a result of this, the Gandak had become a spent force resulting in the '*Kunds*'<sup>2</sup> in the river gradually getting silted up, thus greatly reducing the *habitat* where most riverlife resides in summer.

It is worthwhile noting that the presence of gharial in the canal represents normal high water behaviour of gharial when they leave the swollen main river and seek refuge in a tributary in this case a canal connected to the Narayani.

**Ghaghra river**—Enquiries from fishermen at Ghaghraghat and Dohrightat revealed that gharial which were formerly abundant have now been depleted to the point of extinction in the lower Ghaghra and no adult animals have been seen here for more than a decade.

<sup>2</sup> Deep pools in the river bed.



Fishermen at Dohrihat claimed that migrants are seen immediately after the high water season though the frequency of such sightings have also gone down sharply in recent years. That the Gharial is not yet completely extinct is shown by the fact that the survey party was able to acquire a 1.3 metre long juvenile from a fisherman in October 1975. This animal died after about 3 months in captivity being unable to adjust to captive conditions. Small numbers of gharial used to be exhibited at Dohrihat during the *Kartik* festival held there each year. A superstition based ritual used to be performed on these animals which were later released in the Ghaghra. In 1975 it was seen that turtles had replaced gharial as the object of ritual due to the current rarity of gharials.

It is estimated that over the entire length of Ghaghra there are possibly five isolated gharials.

**Girwa river**—Girwa river which is known as *Karnali* in Nepal before it enters the Indian territory lies in Katarniaghat wildlife sanctuary. From the point of its confluence with Koriala downstream it is known as Ghaghra, about which details have been given in the para above. The stretch of 18 km of Girwa river is at present the best gharial habitat in the State as 5 km stretch of this river has the largest population of gharial in the country.

The population of Girwa was surveyed between March and May 1975 when 14 gharials

including one hump nosed male were counted. During surveys in 1976, 25 gharials including 3 hump nosed males and 7 adult females were seen. The sudden increase in the population observed since the receding of the river after the monsoon season of 1975 is attributed to migrants who have moved into the area from the Karnali gorge, Cheesa Pani in Nepal due to increasing disturbance there arising from surveys for the Karnali Dam Project. Another important reason could be less disturbed basking areas available in this part of the river due to reduced human disturbance, as this year there was no working for timber in the surrounding forests and boats carrying driftwood were absent.

Formerly the gharial was more widely distributed along the entire length of the Girwa downstream of the Nepal border at Katarniaghat. Gharial also occurred at the confluence of the Kauriala and Mohan river and in the Mohan river itself. But at present they are mostly restricted to a 3-5 km stretch of the Girwa adjoining compartment 2 from about one kilometre above the temporary bridge at Katarniaghat. Gharials occasionally show up to the confluence of Girwa and Kauriala and the Kauriala and Mohan rivers after the monsoons but there is a tendency to abandon these areas during the subsequent months.

The details of the gharial population in the Girwa is therefore as follows:

(i) Male	2	17 feet and 20'-21' long
(ii) Female	7	Adult 10'-15' long
	2	adult reaching breeding size
(iii) Sub-adults	4	6' to 10' long
(iv) Juveniles	11	5' to 7' long
(v) Young ones (two years)	2	3' to 5' long
	<hr/>	
Total:	28	
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# MAP OF KATERNIAGHAT SANCTUARY

Scale 1" = 8 Mile



References	
Boundary:-	
„ International	--- ---
„ Outer forest	.....
„ Compartment	.....
Area of Sanctuary	
Railway line	
Metalled road	
Forest Rest House	
River Nadi & Nala	
Reflux Bundh	
Barrage	

**Chambal river**—The river Chambal forms the border between U.P. and Madhya Pradesh for over a length of nearly 250 kilometres. During the period December 75 to January 76, nearly 200 kilometres of Chambal in Uttar Pradesh was surveyed. The survey started by boat from Samruna ghat just above the U.P. Rajasthan border downstream to the pontoon bridge at Sahson Ghat.

The Chambal is generally a deep river flowing between high banks. There are numerous bends where the river is over hundred feet deep. The extensive river habitat of the Chambal supported a large population of gharial and other river life in the past. Indiscriminate hunting and netting has brought the population down to a stage where its survival has been threatened.

A flayed body of an adult male was seen on the banks of a *Kund* close to Ridauli village on the right bank of the river which lies in M.P. The carcass which had not yet begun to decompose belonged to a 17 feet humped gharial which had been stripped of its skinned hump on the nose. Local people reported that it was shot after 5th December by the Chawki-dar of Ridauli village in M.P. Tracks of gharial which had come out to bask belonged to more than one gharial. Near Basauni village in U.P. two small springs which originate in small ponds flow into the river. Here gharials below three metres in length were reported to be trapped since the water receded from the ravines after the monsoon flood. One of these was killed with sticks when a farmer was surprised by the animal as he was washing his hands in the pond.

Several tracks of adults were seen on the submerged portion of a mud bank above Aterghat. Three (3) fresh tracks of juveniles or sub-adults were seen on a mud-bank close to Mau village in M.P. on the right bank. One

juvenile below 1.5 metres in length was seen near Kasaua village on the right bank in M.P.

In the stretch of the river surveyed the number of adult gharials will not exceed 10. In addition sub-adults and juveniles occur in fair number. This is stated on the basis of information collected from villagers working close to the banks of the Chambal. However, the gharials could not be sighted for the following reasons:

(i) Gharials in Chambal come out of water less frequently during December and January and are seen more often before November and after mid February to May.

(ii) Very intensive commercial fishing is done in this river and as many as 25 boats were found operating in the stretch of the river surveyed. Gharials do not come out because of this activity.

(iii) Old adults are very shy and do not completely leave the water but bask by resting their snouts only on land.

(iv) In many places mid river rocks are used for basking and no tracks are left on these.

The river still provides good habitat for gharial, they have disappeared mainly due to hunting. Numerous methods of hunting have been adopted. The important ones are: a) Shooting, b) netting, c) by hooks planted in the sand, d) noosing of juveniles, e) spearing by torch light.

They are also caught accidentally in fishing nets and turtle hooks. A secondary reason may be increasing human activity near the river as indicated by the existence of greater number of ferries on the Chambal than shown in the earlier editions of survey of India maps.

The portion of the Chambal river upstream of U.P. border between Rajasthan and M.P. still contain breeding populations of gharial. Our survey work continued in this part of the



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river as well but its details will form part of another note.

It is however considered necessary to give the abstract of results so that the actual status of the gharial in the country may be assessed. The following are the details of the population observed in this portion.

Male	—	Adults	—	6
Female	—	Adults	—	12
		Sub-adult	—	15
		Juveniles	—	16
		up to two years	—	34
			—	
		Total		83
			—	

The breeding population of gharial in this part of the Chambal gave us during the 1977 egg laying season as many as 12 clutches of 497 eggs. It is therefore justifiably believed that gharial will naturally increase in the U.P.-M.P. portion if their hunting and extermination are completely eliminated.

**Ramganga river** — Ramganga river flows through the Corbett Park. This river debouched into the plains at Kalagarh where a dam has been constructed. It has created a reservoir of nearly 80 square kilometres, submerging the best gharial pools which existed in the river in a stretch of 8 kilometres upstream of Kalagarh. Till 1960, this river had a very large gharial population which could be seen basking on islands and sand bars. The census carried out in 1965 indicated the presence of atleast 15 adult gharials. The construction of the dam, which involved heavy dynamiting of the hills and river banks was responsible for the destruction of the gharials. Now the total population consists of 5 adults, of which two are males and three females. All the gharials live in the pools lying in the stretch between Dhikala and Gairal, a length of nearly 25 kilometres. They share pools with muggers

which are more common in the river now.

Ramganga below Kalagarh is almost a dry river on account of the Kalagarh reservoir. Only a few isolated gharials have been reported in Badaun and Shahjehanpur districts.

**Ganges river**—The portion of the river above Garh Mukteswar is not habitable for gharial due to lack of deep pools and paucity of water.

(i) Between Garh Mukteswar and Kanpur no gharials were observed but reports about the occurrence of several isolated adults have been received.

(ii) Between Kanpur and Allahabad—in this portion gharial has been completely exterminated and no reports about their existence anywhere were received.

(iii) Between Allahabad and Mirzapur—occasional reports of isolated adults have been received till recently.

**Jamuna river**—Below its confluence with Chambal river, some juveniles have been seen occasionally. Sometimes migrants from Chambal stray into Jamuna and isolated adults have been seen in certain areas.

**Betwa river**—Gharial habitat has been badly disturbed in this river due to the construction of various hydel and irrigation projects. The population is accordingly either extinct or near extinction.

**Ken river**—Gharial is extinct in the portion of the river in U.P. A few are reported to survive in the higher reaches in M.P. but they are cut off from U.P. by an irrigation barrage.

**Son and Tons rivers**—Gharial is reported to survive in the river gorges in M.P., but they are almost exterminated in U.P. These rivers used to have a good number of gharials some years back. Only occasional migrants may stray into the U.P. portion of this rivers.

**Rapti river**—No resident population survives in the U.P. portion of the river. In the

portion in Nepal, there are several breeding adults. Occasional migrants may stray into U.P.

The following is the abstract of gharial, populations in the rivers of U.P.

GHARIAL REHABILITATION PROJECT

Less than 1% of all gharials hatched in nature reach a length of two metres after which they generally become immune to pre-

(i) Narayani	2	Sub-adults
(ii) Ghaghra	5	adults (isolated)
(iii) Girwa	2+9	adults
	17	sub-adults & young ones
(iv) Chambal		
(a) U.P.	10	adults (isolated)
(b) M.P./Rajasthan	6+12	adults
	65	sub-adults & young ones
(v) Ramganga		
(a) Corbett Park	5	adults (isolated)
(b) In the plains	4	adults (isolated)
(vi) Ganges	4	adults

**Conclusion**—The results of the survey as given earlier bear testimony to the fact that gharial is uniformly rare to the point of being extinct in most of the rivers in U.P. which not very long ago supported a sizable population. The only breeding population in the entire State exists in the Girwa river of Bahraich Forest Division. The resident population here consists of nearly 30 individuals including 9 adult females and two (2) adult males, the remaining being sub-adults or juveniles. So far only a maximum of four females have participated in nesting. In all other rivers, only isolated individuals may continue to survive, but these are not believed to be of breeding status. Also in case where the upper reaches of rivers lie outside the State boundaries and in which gharial continues to survive, flux of migrating individuals specially juveniles may sometimes be observed after monsoon floods. Reports of such remnant population continue to be received from the river Ghaghra, Ganga between Garh Mukteshwar and Kanpur, the Ramganga, Chambal, and Jamuna rivers.

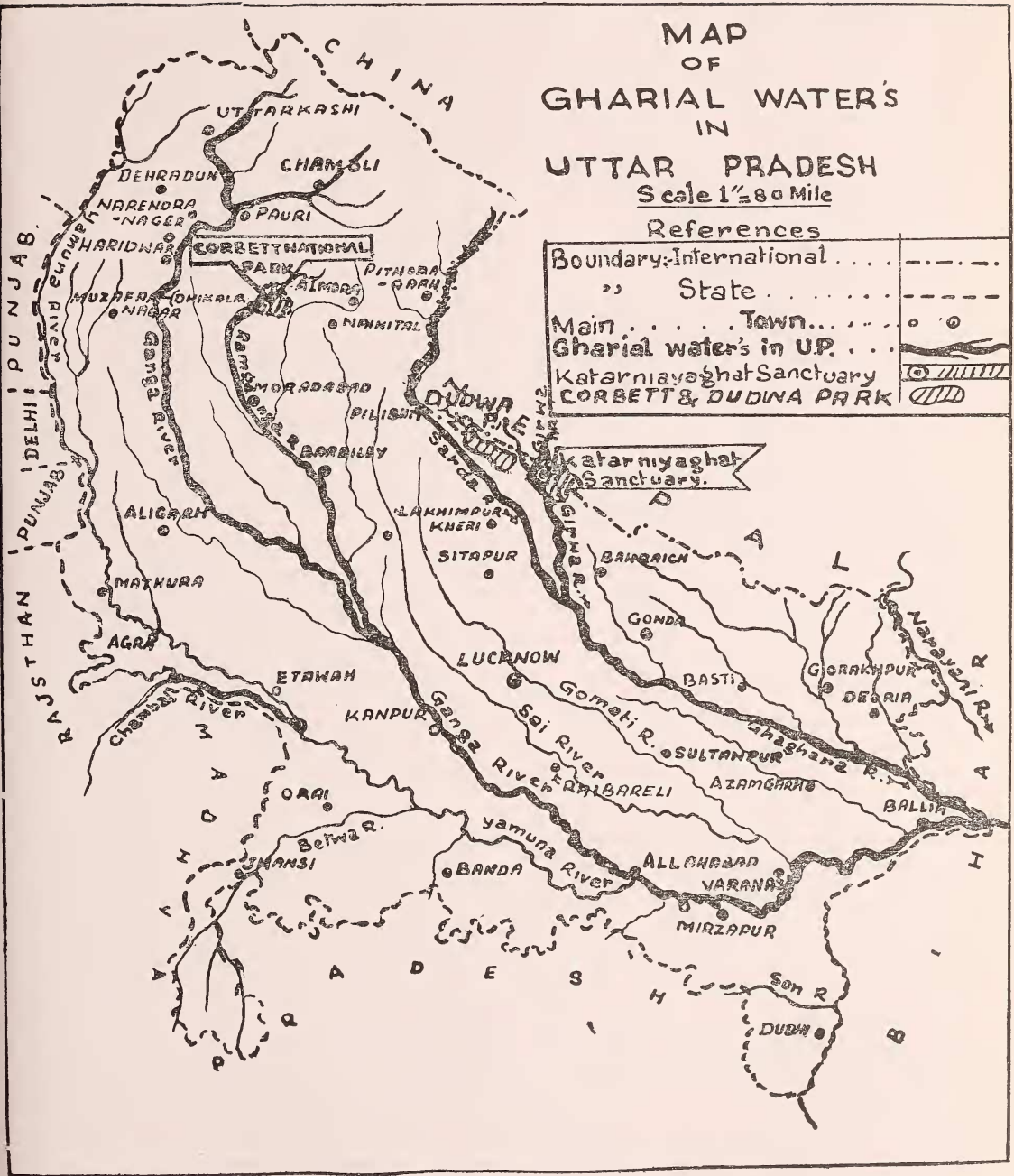
dation. One breeding female may lay eggs from 20 to 100 in a clutch, which is a sufficiently large number to maintain a population if a fair proportion out of them could survive to reach the breeding age. But the eggs and hatchlings fall victim not only to predators like fish, jackals, monitor lizards, birds of prey or even big gharials but also to egg eating tribal communities. All odds were against the rehabilitation of gharials in nature with its rapidly shrinking habitat, the fast flowing and deep pooled rivers being favourite sites for dams, barrages and reservoirs, and the ever present threat of hunting by hooks, rifles, dynamite or nets for their valuable hide. Also young and old alike were being accidentally enmeshed in huge nylon fishing nets and either drowned or were clubbed to death to save the valuable net. There was little hope of rehabilitating the gharial without a crash programme to overcome these difficulties and adverse factors. A project which could take care of protection and which could produce sufficient number of gharial babies to repopulate the rivers was the

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MAP  
OF  
GHARIAL WATER'S  
IN  
UTTAR PRADESH  
Scale 1" = 80 Mile

References

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Main . . . . . Town . . . . .	o o
Gharial water's in U.P. . . . .	
Katerniyaghat Sanctuary	
CORBETT & DUDWA PARK	





need. These objectives could be achieved by:

- (i) Careful collection of eggs from the wild, their artificial hatching combined with captive rearing of the young till they attained a length of nearly 2 metres when they were strong enough to fend for themselves and survive in nature against most of the predators.
- (ii) Creation of sanctuaries to protect the existing breeding population.

*Pilot Project:* The Wildlife Preservation Organisation of Uttar Pradesh decided to start a pilot project to construct breeding ponds and to collect eggs, hatch them and rear the young ones. It was decided to survey rivers to locate breeding populations so that during the egg-laying season likely nesting sites could be watched and eggs collected for our rehabilitation centre. While the preliminary survey was being conducted from December 1974 to January 1975, information was collected about the design and specifications of ponds.

Kukrail reserved forest, which covers an area of nearly 2000 hectares and is located 12 km away from the State Capital Lucknow was selected as the site for the location of the rehabilitation centre. The river Kukrail is perennial and can provide sufficient fish of all sizes for most part of the year and was the main attraction in addition to the closeness of the place to Lucknow which made intensive and frequent inspection of the centre possible. In an enclosure of 12 x 6 metres which was enmeshed on all the four sides and on the roof, two ponds each of 2.25 x 1.90 x 0.4 metre size were constructed with inlets for running water from a tubewell and drain pipes to clean the ponds.

Systematic surveys carried out in February 1975 proved successful and atleast 14 animals were enumerated in the Girwa river near Katarniaghat in Bahraich district. Our staff

managed to locate a single nest of gharial which yielded 38 eggs which were transported in May 1975 to Kukrail for artificial hatching. Twenty one (21) hatchlings emerged in the first week of July out of which one died immediately and the rest were released into the newly built ponds. The centre was visited by the crocodile expert of the FAO/UNDP on the 5th August 1975 and at his suggestion 10 of the hatchlings were sent to the Orissa Rehabilitation for rearing under his supervision. The remaining 11 were kept at Kukrail. Proper arrangements had to be made to protect the hatchlings against winter. The entire enclosure was covered by polythene sheets and jute mats to ward off cold winds and to arrest sun's heat. Electric room heaters were provided for keep in the water in the ponds above 18°C below which hatchlings in captivity tend to become lethargic and susceptible to diseases.

Our experiment in artificial rearing proved successful and at the end of the year 12 hatchlings had survived 8 in U.P. and 4 in Orissa.

Encouraged by this success we presented a full fledged scheme to the State Govt. under which the Central Government was requested to meet the capital expenditure and the State Govt. to pay the recurring expenses. This scheme was sanctioned in October 1975 and a planned total expenditure of Rs. 3.77 lakhs spread over 2 years was allotted by the Central Govt. Technical assistance is also being provided by the UNDP expert posted in the country. We decided to have one more rehabilitation centre which was located at Katarniaghat near the river Girwa. By June 1976, the construction of 30 hatchling ponds with a capacity for 450 hatchlings and 4 yearling ponds with a capacity for 80 yearlings was completed. Ten of the hatchling ponds were located at Katarniaghat centre. Meanwhile survey efforts were stepped up and between December 75

and May 76, our survey team constantly surveyed the Narayani, Son, Ghaghra, Ramganga and chiefly the river Chambal and Girwa to locate more breeding populations and nesting sites of gharial. The efforts were well rewarded and we were able to locate 9 nests out of which 3 were found on the Girwa and the other 6 on the Chambal. These nests yielded us 342 eggs (215 Girwa and 127 Chambal). The Chambal eggs gave us nearly 95% hatching success while it was 71% in the case of Girwa ones. The number of yearlings surviving now (Aug. 77) out of these are 235, Girwa eggs yielded weak hatchlings which suffered from physical defects and their mortality was high during the course of 12 months. Chambal hatchlings, on the other hand were healthier and sturdy.

It became necessary to increase the number of yearling ponds to accommodate the 235 yearlings against our existing capacity for 80 yearlings only. Accordingly 4 yearling ponds were added to the Kukrail complex and another 4 ponds to the Katerniaghat. This raised the total number of yearling ponds to 8 at Kukrail and 4 at Katerniaghat which among them could provide for at least 240 to 250 yearlings. No hatchling ponds were added as we did not expect to collect more than 400 to 450 eggs during the 1977 summer nesting season.

Efforts were intensified to locate maximum number of eggs both along Chambal and Girwa during the 1977 nesting season. Separate survey parties were deputed to these two rivers with adequate number of boats, transport and men both local and our own staff. They stayed in the area from February onwards till they located all the possible nests. As many as 12 gharial nests were located on the Chambal which yielded 497 eggs. These

eggs were brought to Kukrail centre in the last week of May 77. On the Girwa 4 nests were located with 166 eggs. While the eggs from 3 nests were brought to Katerniaghat centre one nest with 30 eggs was left at the site to observe the hatching percentage in nature. The hatching success came to 90 to 94% which yielded 599 hatchlings. The nest which was kept undisturbed on the site at Girwa yielded 30 hatchlings, but 7 died immediately. The twenty three hatchlings were collected and brought to Katerniaghat centre for rearing. We had thus 553 hatchlings from the 1977 eggs. Our existing hatchling ponds, as indicated earlier, have capacity for only 450 hatchlings. We had therefore to resort to relative crowding and had to send 100 Chambal hatchlings from Kukrail to Katerniaghat as a measure of proper distribution of space and work load.

The following table gives the existing stock position of gharial hatchlings and yearlings at our two centres. It also gives consolidated information about the number of nests, and eggs collected during the last three years as also their hatching percentages etc. (see p. 678).

Though this paper deals only with the work done by us about gharial rehabilitation, we also collected mugger (*Crocodylus palustris*) eggs which were found along the Chambal river banks during the course of our survey. We have the following number of mugger hatchlings and yearlings also at our Kukrail centre:

The above figures show that we have in stock 247 gharials which will be big enough to be released in the wild by the end of February 1978.

*Sanctuaries*—As mentioned earlier, Girwa river in Bahraich Forest Division has the largest gharial population in the State. A five

Year	egg source	No. of nests	No. of eggs created	No. hatched	% of hatching	No. of surviving of one year age		No. of surviving at 2 years age	
						No.	%	No.	%
1975	Girwa	1	38	21	55.3	12	57	12	100
1976	Girwa	3	215	153	71	42	27.5	-	-
	Chambal	6	217	206	95	193	94	-	-
Years total		9	432	359	84	235	65	-	-
1977	Girwa	4	166	151	94.5	124			
	Chambal	12	497	448	90	429			
Years total		16	663	599	91	553			

The following table gives the distribution of surviving gharials to centres:

Egg source	Year of egg collection & hatchling	Currently surviving gharial babies being reared at			Total
		Katerniaghat Centre	Kukrail Centre	Tikarpara Orissa	
Girwa river	1975	-	8	4	12
	1976	19	23	-	42
	1977	124	-	-	124
Chambal river	1976	39	154	-	193
	1977	100	329	-	429
	Total	282	514	4	800

Mugger stock position (Kukrail)

Egg source	Year of egg collection & hatchling	Surviving Juveniles being reared	Remark
Chambal River	1976	2	One wild caught juvenile is also reared.
	1977	33	
Total		35	

The position of crocodilians at our centre is as follows:

Year of hatchling	Gharial	Mugger
1975	12	-
1976	235	2
1977	553	33
Total	800	35



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kilometre stretch of this river has the highest density of gharials in the country. Along with the artificial rearing of gharials and their release in nature, their rehabilitation depends on the protection afforded to the existing population as also to the artificially bred young after their release. It was considered necessary to give higher legal status to the entire eco-system which held the largest surviving population of gharials in the State.

The Girwa river and the forest around this river were the obvious choice and an area covering 400 square kilometres was constituted into a wildlife sanctuary in the year 1976. In addition to the breeding population of gharial this sanctuary contains rich wildlife including Mugger, tiger, panther, swamp deer, black-buck, chital, hogdeer, blue bull, pigs and variety of birds including red jungle fowl, partridges etc. The first five species listed above are protected animals included under schedule I of the wildlife Protection Act 1972. In addition to the normal territorial and wildlife staff posted in the area one Assistant Wild Life Warden has been posted for the protection of gharials. A scientific management plan is being drawn for this sanctuary which will considerably improve the habitat and environmental conditions in the area after its enforcement.

There is a proposal to create another sanctuary to cover the length of the river Chambal which has a breeding population of gharials or which has suitable habitat where gharials can live and breed. This sanctuary will be spread over the three states of U.P., M.P. and Rajasthan. Government of India has accepted our proposal in this connection and have initiated action for the early creation of this sanctuary.

Corbett National Park is another protected area in the State which has ideal habitat for gharials in the form of river Ramganga.

Though this river has at present only 5 gharial adults, it can provide a home for more gharials.

The above three rivers have been selected for the release of gharial young reared at our two centres. The first lot of juveniles will be released in February 1978. They will be intensively protected and looked after. In due course other areas which have suitable stretches of gharial habitat, will be given the status of sanctuaries for the release of captive bred gharials.

This paper will not be complete without details of techniques adopted in each operation involved in the rearing of gharial. The different operations are (i) location of nests (ii) Incubation of eggs (iii) Transfer of eggs to centres (iv) Hatching (v) Rearing enclosures (vi) Feeding and (vii) Protection against winter and diseases etc.

*Location of nests:* Gharials have been found to be regular nesters and the nesting season does not vary by more than 10 days in any year. Determination of the nesting season in a particular region is vital for nest location. It was interesting to note the nesting by all the 12 females spread over a stretch of nearly 200 kilometres of Chambal which occurred within a period of 7 days. Pre-nesting behaviour consists of excavation of trial nests by the females which they start about a month before the actual nesting. The excavation of these trial nests gives vital clues to the location of actual nests. Each female gharial may excavate about a dozen trial nests before laying her eggs in one of these. The location of each trial nest is marked by fixing a peg about 3 metres away from the trial nest in perpendicular direction from the waters edge. This ensures the location of all possible nests. After all nesting activity ceases each trial nest is excavated carefully to check the presence of eggs. If the nest is still

not located, the entire nesting area is systematically probed with a 4 mm thick steel rod to a depth of about 45 cm. This usually results in the puncturing of a few eggs with the location of every nest but an experienced prober can bring the incidence down to a minimum.

*Incubation:* Gharials exhibit wonderful nesting habits. Nesting sites are normally so chosen as to give very high incubation success. The incubation medium has the dual quality of allowing good permeability of air as well as proper humidity to meet the moisture requirements of the developing embryos.

This is achieved as a result of balance between the grain size of the sand and its moisture content which varies between 4% to 7% by weight. Furthermore, the eggs are laid at a depth where steady conditions are maintained for the developing embryos. The temperature does not vary much throughout the day neither does the humidity change with the occurrence of rainfall during the incubation months. The range of incubation temperature varies between 25 degrees C (minimum) and 37 degree (maximum) but the range of optimum incubation temperature is considered to lie between 32 degree and 34 degree, which reduces the incubation time and gives better hatching success. In order to reduce the possibilities of mal-effects on embryos from human interference it is most advisable to allow the eggs to remain in the nest for at least 40 days so that partial incubation is achieved and the embryos are not damaged during transport or movement. In no case should the eggs be interfered with within 15 days of their being laid. Some times on account of various reasons females lay eggs in conspicuously bad nesting medium. Such mediums are (i) over moist sand in places susceptible to inundation by the river water (ii) too dry sand (iii) sand grains of too large a size and (iv) sand with

high humus content. In such conditions, eggs should be transferred to better locations close by so that the clutch may be saved from decomposition.

A thumb rule for the testing of proper humidity and permeability of the incubation medium is to compress the sand in the hand. The sand should be cohesive enough to form a ball which when pressed lightly with a finger should crumble again.

*Transfer of eggs:* As indicated in the previous para, the eggs are transferred after incubation has been completed partially. The transfer to the incubation and rearing centres is done in boxes made of wooden planks (about 40 days after they are laid). The boxes are filled with sand from the nesting area as they provide an ideal medium not only for transport but also for incubation.

The boxes should be sturdy and there should be fine slits or holes to allow for the passage of air into the transportation boxes. Several layers of eggs may be transported in one box which should not exceed the size 60 x 45 x 45 cm. Even smaller boxes are preferable.

When the nest is opened for the transfer of eggs, each egg is marked at its highest portion with indelible ink. During removal of the eggs care is taken to retain the original orientation of the eggs as found in the nest. An egg found in horizontal position is removed in the same position and is kept in the box also in the same position. Similarly an upright egg is kept upright without rotation on its axis. The eggs are transferred to the transportation box and kept so that the lowest layer of eggs is separated from the bottom as well as from all the sides of the box by a layer of sand 4 to 6 cm thick. The eggs should be separated from each other also by at least 1.5 cm. The eggs are then transferred as quickly as possible to the incubation centre by the fastest transport available.

## STATUS OF GHARIAL IN U.P.

The importance of avoiding bumps and jerks cannot be over emphasized. Care should also be taken to eliminate chances of the egg boxes overheating.

At the centre the eggs are transferred into incubation cells built of half bricks such that there are sufficient gaps between the bricks to allow free passage of air. The recommended dimensions of the brick cell are 70 cm cube. The eggs are removed from the boxes and kept in these cells with same precaution as were observed in their transfer from the nest to the box, in single layers after artificial incubating medium has been prepared by mixing together sand with the requisite amount of water. Humidity is controlled until hatching by keeping the bricks wet and by spraying water with an atomizer on the top of the incubation medium.

*Hatching:* The completion of the incubation is heralded by the croaking of the embryos, signalling their readiness to hatch. After initial croaking is noticed, a time period of 24 to 36 hours should be allowed to lapse before sand is removed from the incubation cells. By this time almost the entire clutch would have started croaking. The hatchlings emerge almost immediately on dehumification and sever their umbilical cord which attaches the egg shell to them, a shortwhile after. When this occurs the egg shell should be removed from the incubation box for purposes of sanitation and hygiene. After a period of about 48 hours the hatchlings are ready for release into the rearing pools.

*Rearing enclosures:* These are constructed in sets of 10 hatchling ponds, five on either side a central passage. The enclosure containing these ponds has a wall 1 foot high on all four sides and is completely covered by chicken meshwire of  $\frac{1}{2}$  inch mesh size. Internal dimension of each pond is 2 metres square.

Half of the area has a depth of 45 cm while the other half slopes to zero. Each pond has a 25 cm wide apron on all sides. A space of 80 cm is provided all around the pond in each pond enclosure for the hatchlings to move about and for planting palms, which provide adequate shelter and hiding places for the young.

Yearling ponds are built in sets of 4 ponds, two on either side of a central passage. The enclosure is covered with mesh wire as in the case of hatchling pond enclosures. The size of each pond is 4 metre square and depth one metre, which can ideally accommodate 25 yearlings. The ponds are separated from each other with insect proof mesh supported by sawn timber scantlings and railings. A space of 2 metres is provided between the pond and the partition on all sides.

During the construction of the ponds, arrangements are made by laying under ground pipes with control manholes, both to fill water to the ponds and also to drain them out. Adequate number of palms, *Salix* spp and other suitable shade plants are put in around each pond to provide shade, shelter and hiding space, climbers like *Antigonum* sp. are planted around the enclosures which spread out on all the four sides and also on the mesh wire roof and provide a mosaic of shade and sunlight. This is necessary to keep the water in the ponds cool and temperatures below 30 degree C. This climber should be either a species that sheds its leaves during the winter or should be cut back during the winter to allow the maximum amount of sunlight.

*Feeding:* Considerable yolk matter is rapidly absorbed through the umbilical cord of the hatchling into its stomach just before hatching. The yolk further maintains the hatchling for a period after its birth. Gradually nutrition from the yolk matter is supplemented